Module 3: Erosion and Sediment Control Practices

Module 3 Objectives

After completing this module, you will be able to:

- Better understand the practices containing in the ESC Handbook,
- Identify and document important aspects for inspecting each practice; and
- Conduct more thorough onsite inspections

Module 3 Content

3a. Introduction

3b. The Erosion and Sediment Control Handbook

3c. The Erosion and Sediment Control Standards and Specifications

3a. Introduction

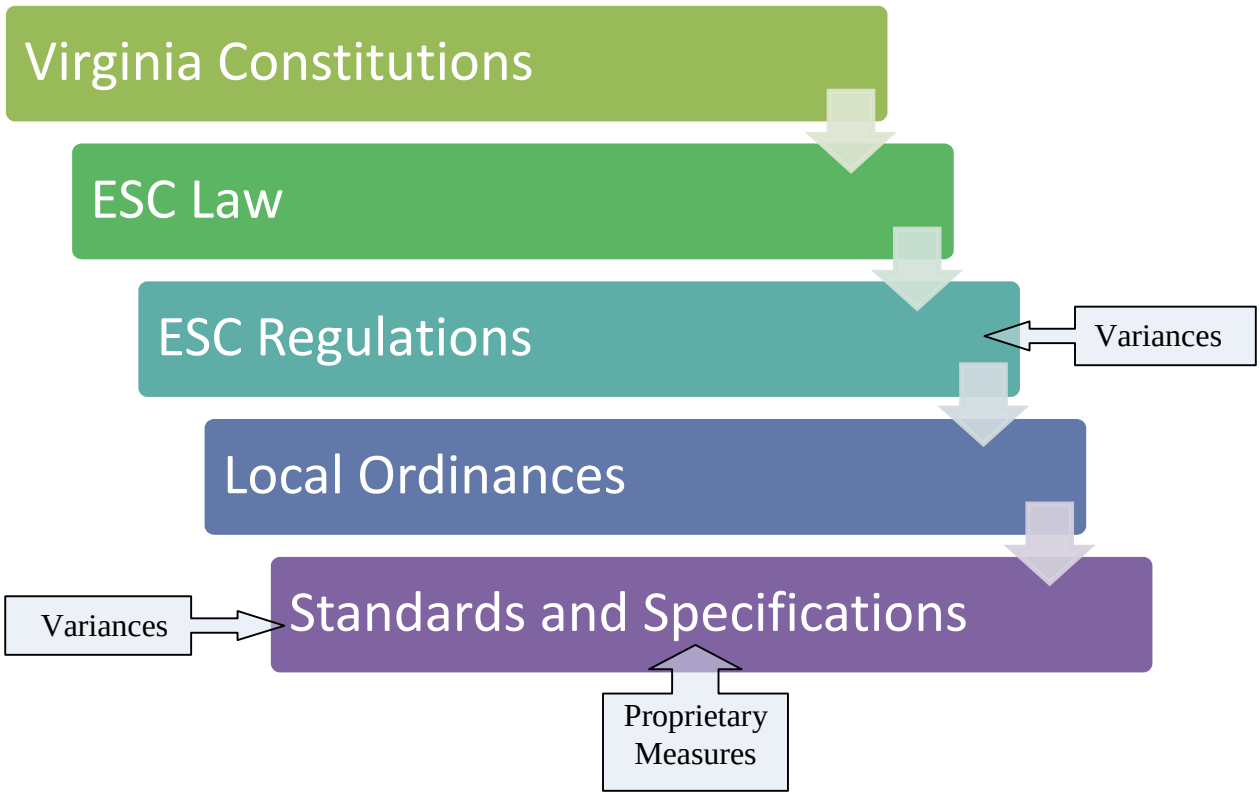
In this section we will discuss common inspection items of the erosion and sediment control measures. We will start out with a brief discussion of the Virginia Erosion and Sediment Control Handbook (VESCH), followed by the standards and specifications of the practices contained in the VESCH.

Inspectors should be aware of any nuances in the local ordinance and any additional measures approved for use by their VESCP Authority. In addition, any given site may have a variance granted to waive or modify certain minimum standards. Since the approved plan is a considered a contract between the developer and the authority, all variances given to a project need to be documented and included on the plan. Documentation should also be on file at the VESCP authority.

On a final note, as discussed in Module 2, not following the approved plan is considered a violation per Section 62.1-44.15:58 (A) of the VESCL.

Erosion and sediment control is ever evolving, and new practices are introduced regularly. While these measures may not be included in the 1992 VESCH and in this discussion, it does not preclude these practices from being used. Many of these practices are proprietary, meaning they are patented and commercially available. Utilization of these practices is authority specific and some authorities may approve these measures.

Inspectors should be familiar with the specifications of these measures, since these can be used for inspection purposes. These specifications can often be found in the manufacturer's (installation and maintenance) specifications which may be on file at the authority or at the project.



3b. The 1992 Erosion and Sediment Control Handbook

The 1992 ESCH is one of the most important guidance documents used for erosion and sediment control. As mentioned in the basic class it contains the following chapters:

Virginia Erosion and Sediment Control Handbook
Table 3-1

Chapter 1	Introduction
Chapter 2 Appendix	Erosion and Sediment Control Principles, Practices and Cost Wall Chart (Unified Coding System)
Chapter 3	State Minimum Standards and Specifications
Chapter 4	Stormwater Runoff
Chapter 5	Engineering Calculations
Chapter 6 Appendices	Preparing an Erosion and Sediment Control Plan 6-A: Soils Information 6-B: Soil Survey Information 6-C: List of Soil Types
Chapter 7 Appendices	Administrative Guidelines 7-A: Sample Administrative Forms 7-B: Enforcement Flow Chart 7-C: Directory
Chapter 8	Virginia Erosion and Sediment Control Law and Regulations
Appendix	Glossary

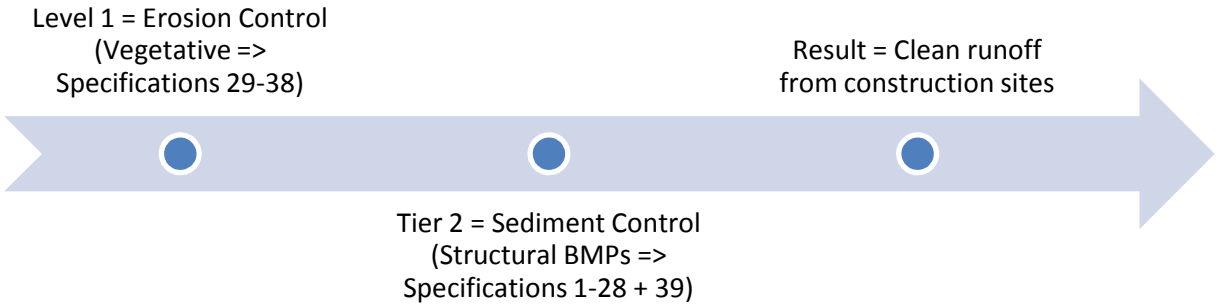
While all chapters contain very valuable information, Chapter 3 (State Minimum Standards and Specifications) should be the "*go to*" chapter for the inspector. As shown below, the 39 erosion and sediment control practices in this chapter of the ESCH are grouped into 14 logical groups. The numbers after the practice refers to the section in chapter 3 of the ESCH.

- Safety (3.01),
- Road Stabilization (3.02, 3.03)
- Sediment Barriers (3.04, 3.05, 3.06, 3.07, 3.08)
- Dikes and Diversions (3.09, 3.10, 3.11, 3.12)
- Sediment Traps and Basins (3.13, 3.14)
- Flumes (3.15, 3.16)
- Waterway and Outlet Protection (3.17, 3.18, 3.19, 3.20, 3.21)
- Stream Protection (3.22, 3.23, 3.24, 3.25, 3.26, 3.27)

- Subsurface Drainage (3.28)
- Site Preparation for Vegetative Establishment (3.29, 3.30)
- Grass Establishment (3.31, 3.32, 3.33, 3.34)
- Mulches (3.35, 3.36)
- Other Vegetative Controls (3.37, 3.38)
- Dust Controls (3.39)

If erosion can be controlled, we do not need to do sediment control

Another way to categorize these practices could be: Vegetative (or Erosion) or Structural (or Sediment) Controls:



Each practice has its own section, and these sections follow the same general outline:

- Definition
- Purpose
- Condition Where Practice Applies
- Planning Considerations
- Design Criteria
- Construction Specifications
- Maintenance

Some more complicated practices such as Permanent Seeding (3.32) and Temporary Sediment Basins (3.14) have additional information including appendices and calculations.

3c. The Erosion and Sediment Control Standards and Specifications

Note that the inspection points in this course material do not address all of the items for which an inspector may need to be attentive. However, this course material only highlights the more common inspection items.

Safety Fence/SAF (3.01)

While safety fences are usually not considered to be a major inspection item for ESC inspector, they can be very important in keeping the public away from the project, steeps slopes, and from other erosion and sediment control measures such as sediment traps and basins. While walking the site, the inspector should be aware of breaches and other damage. Any observed damage should be reported and repaired. Safety fences are also good as tree protection and to protect areas to be used for infiltration as part of the stormwater considerations.

Construction Entrance/CE (3.02)

Construction entrances are stabilized temporary stone pads located at points of vehicular ingress and egress on a construction site. Dirt accumulated on the tires of vehicles is vibrated off due to the stone. In some cases a wash-rack is place on a construction entrance, to remove stubborn dirt.

This practice is a perimeter control and should be inspected during or immediately after installation

Inspection items include:

1. Its dimensions, minimum of 12 feet wide by a minimum of 70 feet long;
2. It has at least 6 inches of VDOT #1 stone (2-3" diameter aggregate);
3. The aggregate is clean and does not have a large accumulation of sediment;
4. It has a filter fabric underliner;
5. In particular when used in combination with a wash-rack, all water draining from a construction entrance should flow to a sediment trapping devise (i.e., a sediment pond);
6. Look for signs of vehicles "cutting corners" where the construction exit meets the roadway, or areas where vehicles leave the site and avoid the construction entrance; and
7. Once excessive sediment has accumulated in the stone, the aggregate may need to be cleaned, top dressed or replaced.

Note: (1) It is important to check construction entrances to see if they are constructed according to the specifications (70 feet long and 12 feet wide), which why we recommend that all inspectors carry a 50 foot long tape measure, so they can measure the construction entrance to see if it was constructed correctly. (2) Tracking of sediment onto public roads is probably one of the main ways the general public gets exposed to sediment deposition from construction sites, and it may be a sensitive issue. This is addressed by MS-17 which requires the removal of dirt on public roads through shoveling and sweeping at least once a day. Washing is allowed, but only after shoveling and sweeping. Inspection of compliance with MS-17 is often done at the same time as the inspection of construction entrances, or during a general walkover and review of the perimeter controls.

Construction Road Stabilization/CRS (3.03)

It is recommended that projects install construction roads and parking areas using stone. It should be noted that the cost savings in controlling erosion and sedimentation, and advantages during wet weather, in many cases will outweigh the installation cost.

Inspection items include:

1. Ensure that all vegetation and roots have been removed prior to installation;
2. Measure the width of the roads to make sure they are at least 14 feet wide for one-way traffic and 20 feet wide for two-way traffic;
3. Make sure that the road and parking areas are covered with VDOT #1 Course Aggregate immediately after grading;
4. The need for top dressing with gravel when it becomes covered with too much mud;
5. The potential stabilization of the sides of the construction roads with a temporary seeding mix; and
6. Any drainage structures that are being crossed by the construction road for the accumulation of sediments.

Straw Bale Barrier/STB (3.04)

This practice is a perimeter control and should be inspected during or immediately after installation

Straw Bale Barriers are not widely used today because they have been replaced by silt fences in the majority of times. When they are still used it is important use the following **inspection items**:

1. Make sure that they are only used for sheet flow and rill erosion control;
2. Make sure they treat only ¼ acre (=10,000 square feet or a 100x100 feet area);
3. Make sure they are not placed in live streams;
4. Are they installed correctly, or placed on contour, in 4" deep trenches, with the binding twine oriented around the sides and anchored with two stakes;
5. Check for undercutting; and
6. Check for sediment accumulation behind the bales and remove it when it reaches half way up the bale.

Silt Fence/SF (3.05)

This practice is a perimeter control and should be inspected during or immediately after installation

Silt fences are probably the most commonly used erosion and sediment control measures in use. The black or orange silt fence is typically visible around most constructions sites. They are used to intercept sheet flow and in low velocity channel flow. However, they are generally less than 60% efficient in capturing the sediment from disturbed areas. Silt fences have a lifespan of at least 6 months and fences made from newer materials may have an increased lifespan, as result of increased UV protection. The inspector should rely on the manufacturer's specifications and observations in the field to determine whether the silt fence needs maintenance or if the silt fence needs to be replaced.

Silt fence can be installed directly on the wooden post, or supported/ reinforced by a wire fence. Installation requirements differ between the two methods, and are detailed below.

It is important to note that both the straw bale barrier and the silt fence are designed for drainage areas smaller then ¼ acre or 10,890 square feet. Note that 10,000 square feet is a 100 ft by 100 feet area, therefore, for every 100 foot section of silt fence the up-gradient drainage area should be no more than 100 feet wide. In other words, there should usually be some other E&S measure 100 foot upgradient from a silt fence.

Inspection items include verifying:

1. The fence is installed on contour;
2. Stake selection (type, size and length);
3. Stakes have a maximum spacing of 6' (10' for wire-backed silt fence);
4. Stakes are installed at the down-gradient side of the fence and the fence is connected to the stakes in the correct way;
5. Height of the silt fence (at least 16" and no taller than 34");
6. New rolls are properly spliced and joined (Fig III-1);
7. Bottom section of the fence is buried in a 4" wide by 4" deep trench;
8. Wire used in wire reinforced silt fence shall be a minimum of 14 gauge and have a maximum mesh spacing of 6 inches;
9. The fence shows no signs of undercutting, tearing or excessive bulging; and
10. Sediment deposits are removed after every storm, or at least when the sediment reached approximately ½ the height of the barrier.

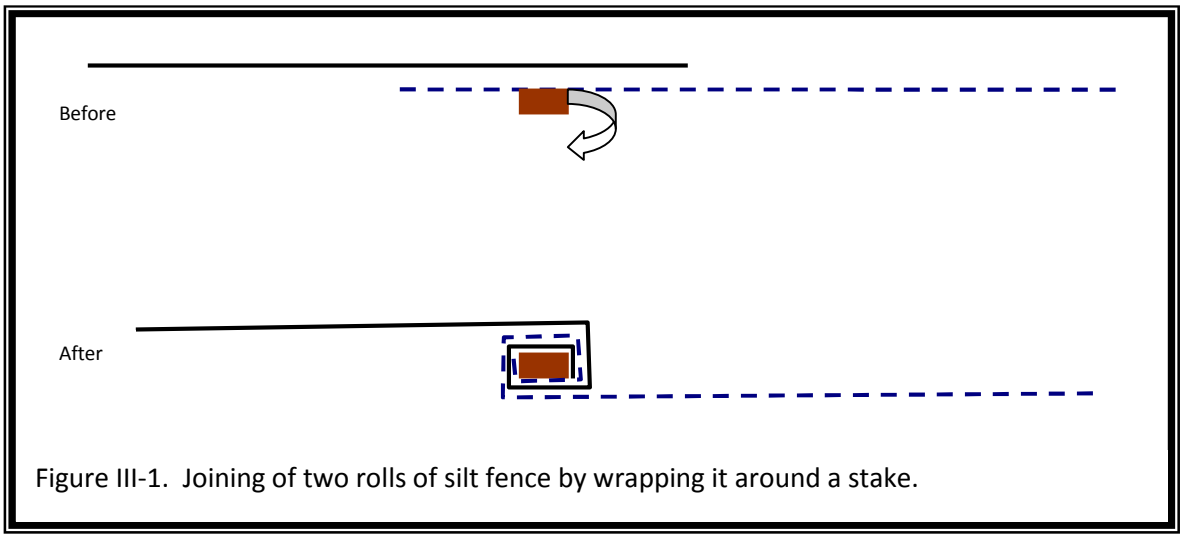


Figure III-1. Joining of two rolls of silt fence by wrapping it around a stake.

Brush Barrier/BB (3.06)

This practice is a perimeter control and should be inspected during or immediately after installation

Brush barriers are primarily a forestry practice, and are strongly discouraged on construction sites. They are also used on linear projects such as pipelines and transmission lines. In the design specifications, the brush takes the place of stakes in a silt fence, and these barriers have similar inspection requirements.

When they are used, it is important the following **inspection aspects are addressed**:

1. Inspect after each rainfall; and
2. Check for sediment accumulation and remove it when it reaches half way up the barrier.

Storm Drain Inlet Protection/IP (3.07)

Construction sites have the potential of generating large amounts of sediment. When sediments are not captured they have the potential to end up in the stormwater system. Maintaining a clean newly constructed stormwater infrastructure is very important but it can be very difficult. Generally, localities expect a clean stormwater system once a project has been completed, and the cleaning out of the stormwater infrastructure after construction is very expensive. The use of vacuum trucks to remove sediment cost upwards of $40 per CY of sediment removed. Moreover, when discharging into the existing stormwater infrastructure care must be taken that it is also protected from excessive sediment loads. One of the ways of achieving this is through protection of the inlets to the stormwater system.

For this section there we consider two types of inlets: drop and curb inlets. Drop inlets are typically located in a larger flat area such as (proposed) parking lots, fields, walkways, etc., while curb inlets are generally located along the curbs of roads. Drop inlets can have and typically do have water infiltration from all four sides and are open from the top, while curb inlets are usually closed from all side except for the side that faces the road. Choice of type of inlet protection is also determined by the location and the surrounding area (i.e. active construction area versus stabilized area versus a public road).

The main purpose of storm drain inlet protection is to prevent or reduce the total amount of sediment from entering the storm drainage system prior to permanent stabilization of the undisturbed area. This must be accomplished without flooding the site. Therefore, a certain amount of filtering needs to take place before stormwater enters the system, while not blocking it completely and inundating the area.

Inspection specifications for drop inlets include:

a. Silt fence

1. Protection should be from one continuous section of material in order to reduce the number of joints;
2. When joining two pieces of silt fence, any joint must overlap two stakes;
3. Bottom 12” of the fence should be buried in a trench that is 12” deep; and
4. Placement of a 2x4 inch wooden frame near the top of the stakes to provide stability.

b. Gravel and wire

1. Verify the correct size stone and wire are used;
2. Verify gravel is at least 12 “ deep and extends a minimum of 18” away from the drain;
3. Verify entire inlet is covered by rock and the underlying wire; and
4. Prompt removal and replacement of clogged stone.

c. Block and gravel

1. Verify block height is between 12 and 24 “ high;
2. Verify correct size stone and wire are used;
3. Verify the orientation of the block is correct stone layer is sufficiently deep; and
4. Removal and replacement of clogged stone.

d. Dirt bag/filter sack

Although this is not included in the ESCH, this method of sediment control has become a commonly used tool. A filter bag is hung inside the drop inlet, where the sack accumulates sediment.

Inspection aspects include:

1. Verify manufacturer instructions and specifications were followed;
2. Verify all water runs through the bag and there is no undercutting; and
3. Ensure that the bag is replaced when full.

Inspection aspects for curb inlets include:

When inspecting curb inlet structures, high water should overtop the inlet protection so that the water can flow into the stormwater system. An inspector needs to ensure stormwater does not overtop the curb and run down a fill slope behind the curb. This would cause major erosion problems of the fill slope.

a. Gravel and wire

1. Verify entire inlet is covered with stone;
2. Verify proper wire and stone size are used; and
3. Removal and replacement of clogged stone.

b. Gravel and wooden weir

1. Removal and replacement of clogged filter cloth and stone;
2. Verify proper wire and stone size are used; and
3. Ensure the emergency overflow is open.

c. Block and gravel

1. Verify proper wire and stone size are used;
2. Removal and replacement of clogged stone; and
3. Ensure the emergency overflow is open.

Inlet protection is one of the areas that has seen the most advances, and there are many more methods available to protect inlets then published in the ESCH. Any new method can be used, but must be approved by the locality where it will be placed. While inspecting, we need to verify they function as designed and that they are not temporarily removed to facilitate drainage during large storm events.

Culvert Inlet Protection/CIP (3.08)

The ESCH includes two forms of inlet protection. These include the use of silt fence and the use of a sediment trap in combination with a stone filter. Inlet protection is mostly done to protect newly constructed or existing stormwater infrastructure.

Inspection items for culvert inlet protection include:

a. Silt fence culvert inlet protection

1. Maximum distance between the stakes is 3 feet;
2. Area above the culvert is also protected with a silt fence;
3. Fence installed ~6 feet from the inlet; and
4. Inspect for torn, damaged or clogged materials.

b. Culvert inlet sediment trap

1. Trap is horseshoe shaped;
2. Proper sizes of stone used on the inside and outside of the filter;
3. Area above the inlet is also protected with rock;
4. Sediment is periodically removed so that the trap functions as designed;
5. No torn, damaged or clogged materials; and
6. Adherence to the same limits, restrictions and specifications as sediment traps.

Temporary Diversion Dike/DD (3.09)

This practice is often a perimeter control and should be inspected during or immediately after installation

Temporary diversion dikes divert sediment laden stormwater away from an undisturbed site towards a trapping device or a stabilized outfall. They generally serve larger drainage areas then silt fences. Alternatively, temporary diversion dikes may be used to divert off-site drainage from entering the construction site.

Inspection aspects for temporary diversion dikes include:

1. Verify construction according to the specifications (18 inches high compacted soil, and no unsuitable material like rocks or roots);
2. Verify immediate stabilization following installation (per MS-5);
3. Verify the dike has a positive grade;
4. Verify it flows into a sediment trap or stabilized outfall; and
5. Verify any repairs are done immediately.

Temporary Fill Diversion/FD (3.10)

Temporary fill diversions divert sediment laden stormwater away from a fill slope that is under construction towards a trapping device or a stabilized outfall. In order to reduce the total amount of water running down a slope, they are constructed on active earth fill slopes at the end of each working day. Temporary fill diversions should remain in place no longer then one week.

Inspection aspects for temporary fill diversions include:

1. Verify construction according to the specifications (one foot away from the slope and at least 9" high);
2. Verify the diversion has a positive grade;
3. Verify it drains into a stabilized outfall;
4. Verify needed repairs are done immediately (when practice in place for more than one day); and
5. Verify they don't remain on site for longer than a week.

Temporary Right-of-Way Diversion/RWD (3.11)

When stormwater runoff runs over the surface of a road, down a slope, it has the potential to increase in both speed and volume and pick up sediment. Temporary fill diversions are 18" low dams (diversions)

constructed across these roads to divert the water to the sides of the road. They are designed so that vehicles can cross them. The objective is to shorten the flow path of the water and thus decrease its energy. The diversions are often constructed with gravel and can either run straight across the road or be constructed in a chevron like pattern. Vehicular traffic is the major reason of any damage.

Inspection aspects for temporary right-of-way diversion include:

1. Verify construction according to the plans and specifications (height and material);
2. Verify proper spacing of the diversions as per Table 3.11-A in the ESCH;
3. Verify they drain to a stabilized channel; and
4. Verify they are inspected at least once every two weeks and repair any damage.

Diversion/DV (3.12)

This practice is often a perimeter control and should be inspected during or immediately after installation

Diversions are defined as a channel constructed across a slope and supported by an earthen ridge on the lower side of the channel. Diversions typically intercept runoff from a slope and divert the water to a stabilized outfall or control structure. Diversions typically reduce the energy of water running down a slope by breaking up the length of travel.

Inspection aspects for diversions include:

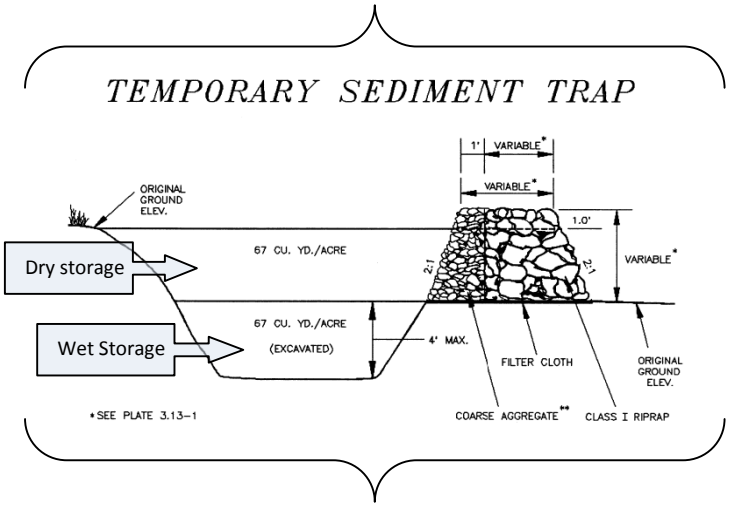
1. Verify construction according to the plans and specifications (slope, compaction and stabilization);
2. Verify the ridge and channel are seeded and mulched immediately following construction;
3. Ensure the drainage area has been properly seeded and mulched; and
4. Verify they inspected at least once every two weeks and repair any damage.

This practice is often a perimeter control and should be inspected during or immediately after installation

Temporary Sediment Trap/ST (3.13)

Temporary sediment traps are small depressed areas or ponds formed by the excavation and construction of an earthen embankment. Sediment traps have an outlet constructed with stone. These stones serve to filter the water from the impoundment. As detailed in MS6, temporary sediment traps shall:

- have a storage capacity of 134 cubic yards per acre of drainage area, and
- treat runoff from drainage areas of **less the three acres**.



Temporary sediment trap storage consists of two parts: dry storage and wet storage. Wet storage includes half of the initial storage volume (67 cubic yards) in the form of a

permanent pool, with the remaining half is known as the dry storage. Wet storage is measured from the bottom of the pond to the bottom of the rock. Dry storage is measured from the bottom of the stone/rock outlet to the crest of the rock. The rock outlet structure is placed on filter cloth, and constructed with larger Class I riprap on the outside and smaller aggregate on the inside of the outlet. The smaller aggregate serves as a filter, while the larger rip rap are placed as a structural element to contain the aggregate.

Inspection aspects for temporary sediment traps include:

1. Verify construction according to the approved plans and specifications (size of the trap; height, width, and length of weir and embankment; stone size; and the embankment is constructed in 6" lifts using clean dirt that has no roots, rock or other objectionable material);
2. Verify filter cloth is installed under the rock outlet;
3. Verify stabilized immediately (as per MS-5);
4. Verify the pond has proper wet storage volume;
5. Verify sediment is removed when half the design volume of the wet storage has accumulated,;
6. Verify the center of the rock outlet at least one foot below the top of the embankment;
7. Inspect at least once every two weeks and repair any damage immediately; and
8. Verify filter rock is not clogged.

How to Inspect a Sediment Trap or Basin (During and/or Immediately after Construction)

1. Using a tape measure or steps, measure the length and width of the trap/basin, and check the plan with the help of your pocket scale. If the contractor does not have the dimensions correct early in the construction process they will never get it.
2. Using a tape, an engineer's rule and a lock level (use your judgment if one isn't available), check the height to the dewatering device or spillway (in the case of a trap) and the height of the dam. Calculate if the correct (required) volume of the basin or trap has been achieved. **Remember, if you do not get the right volume when the basin or trap is first being constructed you will never get the correct volume. Check those things right up front to get them installed right!**
3. On the dewatering device (basin), mark the height or level where clean-out is required. For example, use orange spray paint to do that. In case of traps use a PVC rod or something similar. Having this clearly marked can reduce questions or debate later when clean-out is needed.
4. Inspect the spillways. For Sediment Basins you want to verify, the spillway is NOT located on fill dirt. If it is over fill material, the spillway must be armored. For Sediment Traps, measure the size of the spillway; check if filter cloth has been installed under the rock. Make sure two kinds of rock/stone are used in constructing the spill way; and that the center of the spillway is lower than the sides.
5. Verify vegetative stabilization is applied immediately after construction.

Temporary Sediment Basin/SB (3.14)

This practice is often a perimeter control and should be inspected during or immediately after installation

Sediment basins are required to treat stormwater runoff from **drainage areas 3 acres or larger**. Like sediment traps, they are ponds with a wet and dry storage area. They are typically located in drainage ways by constructing an embankment of compacted soil across the drainage way. They are usually at the most downslope location on the project area, where they receive most of the runoff (but they can never be located in a live stream). MS-6 provides sizing criteria, and the minimum storage capacity should be 134 cubic yards per drainage acre. The storage volume is evenly divided between 67 cubic yards of dry storage and 67 cubic yards of wet storage.

It is important an inspector understands the different parts of a sediment basin, the construction sequence of a basin and maintenance requirements.

Important inspection aspects for temporary sediment basins include:

1. Verify construction according to the plan and specifications, including: the cutoff trench; embankment constructed with the correct soil material and properly compacted (6" lifts and 4" around the barrel); emergency spill way (if used) constructed on non-fill material; inflow into and outflow from the pond is armored with the proper inlet and outlet protection; and immediate stabilization of the practice (as per MS5);
2. Verify the pond has the proper wet storage;
3. Verify sediment is removed when half the design volume of the wet storage has accumulated;
4. Verify the embankment is structurally sound;
5. Discharge is into an adequate channel;
6. Verify de-watering device is functioning properly (not clogged with straw or other material);
7. Examine basin water level. If well below the dewatering device, check to see if the barrel pipe is leaking and allowing for the drawdown of water;
8. Verify baffles (if required) are properly installed and placed;
9. Verify that the low-flow water orifice is **NOT** left open (sediment basins are frequently converted to permanent stormwater structures and contractors forget to close the low-flow orifice open). If the low-flow orifice is open, sediment will flow straight through the basin and not be trapped in the basin;
10. Verify the basin height, cross section of the dam, and the slopes of the dam;
11. Verify a trash rack was installed over the riser;
12. Verify an anti vortex device is installed;
13. If safety fencing and signs are required by the owner/locality, verify they are installed properly; and
14. Verify the integrity of the emergency spill way.

Temporary Slope Drain/TSD (3.15)

Temporary slope drains are flexible tubes or conduits that bring water from the top of a slope to the bottom of a fill slope. Temporary slope drains are usually associated with temporary diversion dikes (3.09) that bring runoff to a collection point from where it is safely conveyed down the slopes using the drains. Using this method, the only water that will run down the slope is rainfall that actually falls on the slopes.

Inspection aspects for temporary slope drains include:

1. Verify construction according to the plan and specifications including a flared outlet;
2. Verify compaction & stabilization of the dike leading to the temporary slope drain;
3. Verify dike height is 6" taller than the diameter of the pipe used as temporary slope drain and entrance of the drain is located at a low point and has a small depressed area that collects water;
4. Verify entrance of the drain has a slope of ½ inch per;
5. Verify tubing has been staked;
6. Verify proper outlet protection at the bottom of the drain and possibly sediment trapping measures are installed; and
7. Verify inspections performed at least weekly and any damages are repaired.

Paved Flume/PF (3.16)

Paved flumes are permanent concrete channels that are constructed down a slope. They have specific design criteria including the ability to pass the peak flow from a 10-year storm.

Inspection aspects for a paved flume include:

1. Verify construction according to the plan and specifications;
2. Conduct inspection after each rainfall, until final stabilization has been achieved;
3. Continued periodic inspection after stabilization to ensure continues functionality; and
4. Verify proper outlet protection has been installed as well an energy dissipater (if required).

Special Note: Flumes constructed on a cut and fill slopes may be particularly sensitive to erosion and may need an occasional inspection for undercutting or other problems for the first year even after final stabilization (MS-7).

Stormwater Conveyance Channel/SCC (3.17)

Stormwater conveyance channels are permanent waterways used to safely convey stormwater runoff within or away from a developing area. Stormwater channels will be shaped, sized, and lined to meet the specifications for capacity as outlined in MS19.

This practice is often a perimeter control and should be inspected during or immediately after installation

Inspection aspects for stormwater conveyance channels include:

1. Verify construction according to the plan and specifications;
2. Verify outlet is properly constructed (see 3.18);
3. Verify proper vegetation establishment (if required by the plan) prior to being made operational;
4. Determine if scour exists under blankets and matting;
5. Determine if scour exists under the rip rap lined channels;
6. Verify filter fabric if the proper lining is installed under riprap;
7. Periodic inspection for undermining and sediment deposition; and
8. Verify discharge located in an adequate channel, pipe or pipe system.

Outlet Protection/OP (3.18)

Outlet protection is used to dissipate the energy of runoff being discharged from pipes or conveyance channels. They typically consist of structurally lined aprons for which the length and width depends on the tail water conditions on the conveyance structure. Apron lining material is riprap that is **placed at a 0.0% grade**.

Inspection aspects for outlet protection include:

1. Verify outlets installed at a project site;
2. Verify construction according to the plan and specifications;
3. Verify outlets are constructed correctly with 0% grade;
4. Verify a smooth transition exists between the riprap and the native soil at the end of the outlet;
5. Verify the outlets fall out into a drainage way;
6. Periodically inspect for undermining and sediment deposition; and
7. Verify outlet protection extends into the receiving channel.

Note: Plans should include a list/table of all outfalls and the dimensions of the outfalls. (1) It is important during the first inspection that you measure the dimensions (width, length, thickness, and grade) of the outfall protection to verify the outfall protection was constructed according to the specifications in the plan. Also make sure that filter cloth has been placed underneath the riprap and that outlet protection was constructed with 0% grade. (2) It is important that all outlets are routinely inspected, as they are often the area where problems with erosion and sediment control first manifest.

Riprap/RR (3.19)

Riprap are large, loose, angular stones that line channels, drop structures, shorelines, toe of slopes and other areas that are erodible. Riprap is considered permanent and should have a filter fabric underlining. Riprap comes in various sizes and grades, and selection of size depends on the energy expected. The minimum thickness of riprap shall be 2 times the maximum stone size and should be laid to its full thickness in one operation. In addition, riprap should be placed, not poured down a shoot or slide because the stone will segregate by size if disbursed that way. Once it has been put down correctly riprap will require little inspections and maintenance.

Inspection aspects for riprap include:

1. Verify there is a filter fabric underlayment;
2. Verify the correct stone size is used;
3. Verify the riprap is laid down correctly (in one lift);
4. Initial inspection and after high water flow to verify filter fabric has not dislodged and no scouring underneath the rock;
5. The design volume for in channel use must be maintained; and
6. When placed on slope rip-rap should be keyed in at base of slope.

Rock Check Dams/CD (3.20)

Rock check dams are small temporary dams constructed across swales or drainage ditches. They are constructed of course aggregate or a combination of aggregate and riprap, depending on the drainage area. They should have a "smile", or depressed area in the middle of the dam, to guide water to the middle of the dam. Constructing check dams this way creates a low point in the center allowing water to be channeled over stone and not over more erosive earthen materials. Finally, they should be spaced such that the toe of the upstream dam is at the same elevation as the top of the downstream dam. This will reduce scouring potential in the channel.

Inspection aspects for rock check dams include:

1. Verify correct stone size is used;
2. Verify stone was laid correctly and the center of the dam is lower than the edges;
3. Verify stone extends to top of bank of channel;
4. Inspect initially and after high flows;
5. When accumulated sediment exceeds half the height of the dam remove sediment;

Level Spreader/LS (3.21)

Level spreader is a relatively low cost practice that can be used to convert concentrated low sediment flow to sheet flow and release it uniformly into a stable vegetated area. Level spreaders are constructed on undisturbed soils.

Inspection aspects for level spreaders include:

1. Measure it verify construction as per the design in the approved plan;
2. Verify the level spreader lip is level (0% slope);
3. Verify water drains to a stabilized area with natural vegetation and with a slope < 10%;
4. No construction traffic is allowed to drive across a level spreader and damage should be repaired immediately; and
5. Verify debris does not collect or accumulate at one end of the level spreader and that the spreader remains level.

Note: Maintenance of level spreaders (including debris removal in item 5 above) is critical. Otherwise, water will concentrate and flow out of the level spreader as concentrated flow but not sheet flow as designed.

Vegetative Streambank Stabilization/VSS (3.22)

This practice addresses the use of vegetation in the stabilization of streambanks. This practice is mostly used in stream restoration projects. **Inspection** aspects would include:

1. Reconnaissance of stream to observe erosion features;
2. Verify stabilization occurs immediately after the streambank work ends; and
3. Ensure proper installation of erosion control materials and fabric as per approved plan.

Structural Streambank Stabilization/SSS (3.23)

This practice addresses the use of permanent structural measures in the stabilization of streambanks. This practice is mostly used in stream restoration projects in high energy situations and shoreline stabilization. **Inspection** aspects would include:

1. Verifying measures are installed according to the improved plan; and
2. Reconnaissance of any erosion features, which need immediate restoration.

Temporary Vehicular Stream Crossing/SC (3.24)

MS-13 requires a temporary vehicular stream crossing be constructed when a live watercourse is crossed more than twice in any six-month period. Temporary vehicular crossings include bridges and culverts.

Inspection aspects for temporary vehicular crossing include:

1. Verify construction according to the approved plan and specifications;
2. Ensure temporary crossings are lined with non-erodible materials;
3. Determine sediment trapping measures have been installed for capturing runoff from the roads leading to the stream crossing;
4. Verify the stream is crossed at a right angle; and
5. Provide periodic inspection and immediate repairs for damage.

Utility Stream Crossing/USC (3.25)

While this practice is used less with the advent of directional drilling, it may be used when crossing a small stream with a utility line. Typically a stream is diverted into a temporary channel while work is done in the dry stream bed, so as to avoid sediment entering a waterway. Prior to making the crossing operational (i.e. commencing construction), the operator needs to ensure the downstream end of the diversion is not blocked. . All work at the location of the Utility Stream Crossing is in a critical area because it is either in a stream or very near a stream. Therefore, the inspector must pay particular attention to both sequencing and how the work is done. Flow to the stream is restored once work is completed.

Inspection aspects for utility stream crossings include:

1. Verify plastic or fabric linings are properly installed ensuring that :
   a. A minimum of a 18” overlap of the upstream material exists over the downstream material; and
   b. The material has been properly entrenched and secured;
2. Inspect after each working day to ensure that the working area remains dry;
3. Ensure any potential blow-out points are repaired immediately;
4. Verify dewatering of work areas is discharged through a filtering device; and
5. Diversion of the stream back to the original streambed occurs only after stabilization.

Dewatering Structure/DS (3.26)

Dewatering structures are temporary settling and filtering devices for water discharged from dewatering by means of pumping. They are generally constructed of a box lined by filter cloth or a standalone filter bag.

Inspection aspects for dewatering structures include:

1. Ensure they are not placed in areas where the discharge will erode stream bank;
2. Ensure the structure is not overfilled;
3. Ensure proper settlement of sediment fines before pumping out of a dewatering structure;
4. Verify dewatering structure has the required volume (16 cubic feet for each g.p.m. of pump capacity);
5. Note any sediment build up or damage and repair or replace immediately; and
6. Verify accumulated sediment disposal is consistent with approved plan.

Turbidity Curtain/TC (3.27)

Turbidity curtains are floating geotextile materials that provide sedimentation protection for live water courses. **Inspection** aspects would include an occasional review of the material to make sure the geotextile is not damaged. Removal of the curtain must be based on a final inspection and can only be done when sediment has sufficiently settled.

Subsurface Drain/SD (3.28)

This is a perforated subsurface pipe, tubing or tile to intercept and convey ground water. Subsurface drains are used in erosion and sediment control, in areas that are excessively wet.

Inspection aspects for subsurface drains include:

1. Periodically verify water is free-flowing and the pipes are not clogged with sediment; and
2. Outlets and surface inlets need to be kept free of sediment and debris.

Surface Roughening/SR (3.29)

Surface roughening is used mostly on slopes to facilitate water infiltration and plant establishment. Horizontal depressions are created in the soil surface with bulldozer cleats, bulldozer blades, discs, tillers etc. Methods used depend on slope angle, slope length post disturbance land use, and whether we are working on a cut or fill slope.

Inspection aspects for surface roughening include:

1. Verify groves, cleat tracks or other roughing is oriented horizontally (not vertically);
2. Verify area is seeded and mulched in a timely matter; and
3. Ensure areas are inspected for excessive erosion features (particularly) after heavy precipitation events and repaired.

Topsoiling/TO (3.30)

Topsoiling is the method of stripping, storing and spreading the surface layer of disturbed soil in order to obtain a more desirable planting and growing medium after a project area has been completed. Soil may be amended with organic matter or fertilizers during or after the spreading phase.

Inspection aspects for stripping include:

1. Verify perimeter controls are in place prior to stripping;
2. Avoiding stripping of soil when it is frozen or wet; and
3. Limit areas to be strip to those designated for construction.

Inspection aspects for stockpiling include:

1. Verify stockpiles are stabilized in accordance with MS2; and
2. Verify both perimeter controls and permanent seeding within 7 days of completion of the stockpiling are in place.

Inspection aspects for spreading include:

1. Verify subsoil and topsoil are not frozen or extensively wet;
2. Ensure proper site preparation by grading and liming;
3. Ensure subsoil is loosened to provide a good bond between the subsoil and the topsoil;
4. Verify topsoil is spread to a minimum depth of 2" on 3:1 or steeper slopes and 4" on flatter slopes; and
5. Ensure good contact between the subsoil and topsoil.

Temporary Seeding/TS (3.31)

Research has shown that a good vegetative cover is approximately 90% to 100% efficient in reducing erosion and that it is by far the least expensive method in erosion and sediment control. This practice includes the establishment of a temporary vegetative cover on disturbed areas by seeding appropriate, rapidly growing annual plants (MS-1). The objective is to get a fast establishment of a ground cover and a root system that will protect the soil from further erosion. The ESCH provides a list of species that can be used for this purpose.

Inspection aspects for temporary seeding include:

1. Determine if denuded areas will remain dormant for longer than 14 days
2. Ensure proper soil/seedbed preparation;
3. Verify species selection and amount of seed (seeding rate);
4. Determine proper liming and fertilizing application (liming might not be economically defensible when done on areas not at final grade);
5. Verify the area is mulched; and
6. Potential reseeding when germination is poor.

Permanent Seeding/PS (3.32)

After projects are completed the area generally will need to be stabilized (MS-3). In most cases this will mean seeding as a way of establishing vegetation, in particular lawns and naturalized areas. In addition

to its aesthetic value, a permanent vegetative cover will also reduce erosion. As inspectors we are concerned about the proper execution of the erosion and sediment control plan. We are less concerned about species selection or site planning, but, more concerned about: a) proper site preparation, b) the seeding process, c) mulching, d) plant establishment and maintenance, and e) any ongoing erosion during the plant establishment phase.

There are a numbers of reasons why permanent seeding could fail at times. Therefore, it is recommended that the following items be considered when seeding:

1. Ensure the soil contains sufficient amounts of fine grained materials and a good structure;
2. Verify the soil is at least 12 inches deep (to bedrock or impermeable layer);
3. Ensure the soil has been tested by a soils laboratory and recommendations for the soil pH and nutrient content are implemented;
4. Ensure the soil is free of toxic materials and excessive amounts of weeds;
5. Ensure the soil does not contain large amounts of rocks, woody materials and construction debris;
6. Ensure the landscaping contractor uses certified seed; and
7. Retest the soil if initial vegetation establishment is poor (i.e., less than 40% cover).

Inspection aspects for the seeding process include:

1. If a seed mixture is used, ensure the seed is mixed at the correct proportions;
2. Ensure seed is spread uniformly over the site; and
3. Ensure the site is properly mulched (see 3.35).

Inspection aspects for vegetative maintenance include:

1. Ensure the area is irrigated as needed; and
2. Ensure the area is reseeded if vegetation fails to establish.

Sodding/SO (3.33)

Like permanent seeding, sodding is done to establish a permanent vegetative cover at a site. However, sodding provides immediate results, and protects the soil almost immediately. In addition to its aesthetic value, a permanent vegetative cover will also reduce erosion. As inspectors we are concerned about the proper execution of the erosion and sediment control plan including: a) proper site preparation, b) the sodding process, c) plant establishment and maintenance, and d) any ongoing erosion during the plant establishment phase. Many of the inspection items for seeding also apply to the sodding process; however, the most important item is to provide good contact between the roots and the soil.

Inspection aspects for site preparation include making sure that the site has an optimum planting bed by:

1. Ensuring the soil contains sufficient amounts of fine grained materials and a good structure;
2. Ensuring the soil has a smooth, level surface;
3. Ensuring the soil has been tested by a soils laboratory and the soil pH and nutrient content is adjusted as recommended; and

4. Ensuring the soil does not contain large amounts of rocks, woody materials and construction debris.

Inspection aspects for sod installation include:
1. Ensuring certified sod is used;
2. Ensuring the sod is installed within 36 hours of harvesting;
3. Ensuring the soil was slightly irrigated if sodding occurs during very dry weather;
4. Ensuring the sod is laid in staggered rows;
5. Ensuring the sod is tightly butted against each other;
6. Ensure sod installed on steep slopes or erosion impact areas is stapled; and
7. Ensure sod is unrolled to provide soil contact.

Inspection aspects for maintenance include:
1. Ensure the area is irrigated as needed;
2. Verify first mowing is not done until the sod is firmly rooted (usually after 2 to 3 weeks); and
3. Verify no more than one third of the grass height is cut during the first mowing.

Bermudagrass & Zoysiagrass Establishment/BE/ZE (3.34)

Bermudagrass and Zoysiagrass are both warm season grass species that spread aggressively through root stolons. Small pieces of plants are planted or scattered over a site; establishment is more rapid than seeding and less expensive than sodding.

Inspection aspects for site preparation include ensuring the site has an optimum planting bed by:
1. Ensuring the soil contains sufficient amounts of fine grained materials and a good structure;
2. Ensure the soil has a smooth, level surface;
3. Ensure the soil has been tested by a soils laboratory and the soil pH and nutrient content is adjusted as recommended; and
4. Ensure the soil does not contain large amounts of rocks, woody materials and construction debris.

Inspection aspects for the sprigging and plugging process include:
1. Verifying the contractor uses certified plant materials;
2. Ensure the plugs/sprigs are planted within 36 hours of harvesting;
3. Ensure the plants are planted between May 1 and July 15; and
4. Ensure they are planted in sunny locations (both grass species are intolerant to shade).

Inspection aspects for maintenance include:
1. Ensure the area is irrigated as needed;
2. Ensure replanting if necessary;
3. Mowed when needed; and
4. Use water soluble fertilizers.

Mulching/MU (3.35)

The two major purposes for using mulch is to:

- protect the soil from raindrop impacts, thus reducing erosion, and
- provide a favorable microclimate for seed germination and plant establishment.

Mulches are generally used in combination with permanent seeding or during periods when the area cannot be seeded (but a ground cover is required). Types of mulch include: straw, hay, corn stalks, wood chips, bark, and fiber mulch. Mulches such as straw or hay are easily blown around by wind and may require to be crimped into the soil or application of a binder. Binders are sprayed on the mulch to bind them to the soil. Fiber mulch is not adequate during hot dry summer months or when trying to establish late fall cover. During those times, fiber mulch may be used to tack straw mulch; but, it is not to be used alone.

Blankets and matting (3.36) are a special type of mulch but used on steeper slopes or in areas with high energy from stormwater.

Inspection aspects for mulching include:

1. Ensure straw mulch is spread at a rate of two tons per acre;
2. Ensure straw mulch is crimped or anchored to the site;
3. Ensure the mulch is evenly distributed; and
4. Ensure mulch is reapplied if it gets washed or blown away.

Soil Stabilization Blankets & Matting/ B/M (3.36)

Soil stabilization blankets are protective coverings or mat that are placed on top of planting areas located on steep slopes, channels or shorelines. They are generally divided into two classes:

- Treatment 1 is a (bio) degradable blanket used to protect the soil from raindrop impacts on slopes steeper than 3:1.
- Treatment 2 mats are non-degradable plastic structures which can be filled and planted. These mats become part of the soil surface and are resistant to the high energy generated by stormwater.

As inspectors we are more concerned about the proper installation of the blankets and matting (and less concerned about the type or site planning). In most cases the installation and use of the materials is very manufacturer specific and the site contractor is advised to adhere to those specifications.

Inspection aspects for blankets and matting include:

1. Ensure they are constructed according to the approved plan, specifications in the VESCH and manufacturer recommendations;
2. Ensure installation on a relatively smooth soil with no clods, rock, or rills;
3. Ensure there is proper contact between the material and the soil by laying them loosely on the soil (note: stretching the blankets and mats will lift the materials and reduce soil contact);
4. Confirm if check slots are required and if so verify if they are installed properly;
5. Confirm proper orientation in accordance with the VESCH;

6. Ensure manufacturer's specifications on stapling or staking are followed; and
7. Inspect for undermining and undercutting until permanently vegetated and stabilized.

Trees, Shrubs, Vines & Ground Covers/VEG (3.37)

This category includes stabilization of an area with vegetation other then with turf (lawn). In addition to its aesthetic value, a permanent vegetative cover will also reduce erosion. The need for a permanent vegetative cover is also addressed by MS1, MS3, and to some extent by MS5 and MS7. As inspectors we are concerned about the proper execution of the erosion and sediment control plan. We are less concerned about species selection or site planning; but instead, more concerned about proper site preparation, the planting process, mulching, plant establishment and maintenance, and any ongoing erosion during the plant establishment phase. When in doubt, you can check with your locality's extension agent to determine the proper planting techniques.

Inspection aspects for establishing tree or woody vegetation include:

1. Ensure that good, vigorous plant material is being used; and
2. Ensure the plants are properly planted, watered, and mulched

Tree Preservation & Protection/TP (3.38)

Preservation of the native vegetation is one of the most important factors in erosion control. When the development plan calls for the preservation of trees, care must be taken to protect both the above and below ground parts of the trees from mechanical and any other injury. Tree protection starts with plan development, continues with the pre-construction conference and includes the marking of trees and the placement of tree protection measures. Subsequently the developer/contractor needs to make sure that the trees are protected by: (a) flagging, fencing and armoring; (b) preventing equipment storage and operation near the trunk; (c) the prevention of fires; and (d) prohibition of toxic material storage under the canopy.

Inspection aspects for tree preservation and protection include:

1. Ensure protection installed at the drip line to minimize root damage from equipment;
2. Review the tree protection areas for potential infringements (such as vehicle parking, storage and other damage); and
3. Ensure the fencing and armoring is not damaged.

Dust Control/DC (3.39)

Fugitive dust can be a significant cause in air pollution and it's important to control emissions. Excessive dust can contribute to health problems of neighbors, especially if they have pre-existing respiratory problems. Dust can also lead to complaints from deposits on cars, houses and other property. Major sources of dust are bare areas, haul roads, and general construction activities. It should therefore be a major responsibility of an inspector to recognize issues with dust control and to make sure the contractor addresses dust suppression when it is needed. Bare areas generally benefit from

revegetation, mulching, irrigation and sometimes plowing; construction roads benefit from irrigation, spray-on adhesives, stone, and calcium chloride applications.

Inspection aspects for dust control include:

1. Dust control methods should be based on the source;
2. When vegetation is used, establishment must be sufficient and in accordance with standard and specifications 3.32 and 3.35;
3. Water irrigation will be needed when the soil dries out; and
4. When spray-on-adhesive is used, ensure application is applied evenly and refreshed when needed.